Heterogeneous Condensation of Nanoparticles of Uranium Dioxide

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Vapor deposition is one of the basic methods for producing nanoscale particles, ultrafine powders, coatings and thin films. Vapor deposition is based on evaporation and condensation processes so it is very important to study them. In this paper heterogeneous condensation of nanoparticles of uranium dioxide has been investigated by a sub-second optical technique with laser heating. The sample is placed in the center of the hermetic integrating sphere filled with inert gas to reduce the sample evaporation at high temperatures. The sample heating is performed by powerful laser beam. The cooling curves of the sample after switching the laser off are recorded by a fast micropyrometer. Spectral reflectivity and emissivity of the sample surface have been measured by the probing flash method. It has been experimentally shown that the nanoparticles are formed above the sample surface during its laser heating under certain experimental conditions. Heterogeneous condensation of these particles on the sample surface is observed during the sample cooling after switching the laser off and manifested as the exothermal condensation peak on the cooling curves. The vapor condensation takes place at various temperatures depending on the experimental conditions and “movement” of the condensation peak on the cooling curve is observed. It has been discovered that there was a correlation between the process of the sample cooling after switching the laser off and the conditions of laser heating of the sample investigated. The true temperatures of these “moving” transitions in uranium dioxide depend on the sample heating or its cooling rate. In increasing the heating rate, the temperature of the heterogeneous condensation increases as well. The ability to change the heterogeneous condensation temperature enables one to regulate and control the process of modification of the sample surface.